hide under anything they can see through. Burlap bands should be taken off and stored or else changed every year.

VICE-PRESIDENT G. A. DEAN: The next paper will be read by Mr. George G. Becker.

THE CONTROL OF THE ROUND-HEADED APPLE TREE BORER

By GEO. G. BECKER, *Fayetteville, Ark.*

The investigations discussed in this paper were carried out at Berryville, Arkansas, in an orchard which represented as bad an infestation of the Round-Headed Apple Tree Borer as has ever come to the writer's notice. From 50 to 75 per cent of the trees of this eight-year-old orchard had been killed by this insect, though the shallow soil may have been a contributory cause to the death of some of the trees. No trees could be found in the orchard which did not show the work of the borer.

In 1913, a few over 1,000 one- and two-year-old apples trees were set out in this orchard. Trees were set out five feet in rows and ten feet between the rows. There were 67 trees to a row, and three to four rows to a plot. Plots were set out in alternate middles, so that each would have a vacant middle on either side. White Lead Paint ,Sherwin-Williams' Pruning Compound, Screening, and Asphaltum, in varying combinations with oils, were tried out. Except for the screened trees, all were treated at Fayetteville and tied in bundles of 10 to 13 to insure that the different treatments would be well scattered out over the plots. It was thought that Asphaltum might have different effects on different varieties and, accordingly, all the tests were carried out with three varieties.

WHITE LEAD

Previous experiments with white lead were conducted by Professor Hayhurst, and the author, in 1911, but our data were not conclusive enough. Accordingly, ninety-nine trees were incorporated in the tests at Berryville. Four per cent. of the trees were infested, this representing a protection of 56.7 per cent. Hayhurst, in 1911, found that beetles confined in a cage with twigs coated with white lead, ate through the paint. It is not unlikely that this would happen in the field. Our experiments on white lead were not continued a second year. From our tests we concluded that:

1. Trees would have to be retreated each year.
2. The protection obtained was not commensurate with the cost.

Pruning Compound

A paint by-product, known as Sherwin-Williams' Pruning Compound, was tried in the tests. It was thought that this material might be as efficient as white lead, and at the same time would be cheaper. Ninety trees were treated, of which ten were infested, representing an infestation of 11.1 per cent, and a protection of −3.7 per cent. In other words, these trees were more heavily infested than the checks. Beetles ate through the paint and the material cracked and flaked badly, and it was not considered worthy of a second trial.

Conclusions: Sherwin-Williams' Pruning Compound offered no protection against the Borers.

Paper Wrappers, Wooden Tree Veneers, etc.

Although these were not tested out at Berryville, it might be well to give a few notes regarding their use. In 1911, Hayhurst observed an instance of where a beetle in eating its way out of its pupal cell had eaten right through a tarred felt wrapper which was over the place where it emerged from the tree.

It has been the author's observation that various paper wrappers are inefficient, either because they rot or else because of the fact that they are torn and made useless by termites or ants.

It was further observed in the old orchard at Berryville that trees wrapped with newspapers, as a protection against rabbits, almost invariably harbored under these wrappers a colony of ants. These ants were observed attending a species of pseudococcus, and it is not unlikely that they would establish symbiotic relationship with the Woolly Aphis.

Wrappers also tend to keep the trunks of the trees cool and moist, and it was observed that the conditions thus established were especially conducive to attacks of *Synanthedon pyri*, which insect is quite common in the Ozarks. At any rate, Synanthedon seemed to thrive especially well under the paper wrappers. The same objections would perhaps be found with wooden tree veneers. Moreover, if our screening tests would be indicative, this veneer would have to be altered each year to allow for growth of the trees, which would add to the cost of their use as protectors.

Conclusions: 1. Paper wrappers and tree veneers may be dangerous on account of harboring other insect pests.

2. The retreatment and readjustment each year would perhaps make the cost out of the question.

Screening

The use of 12-mesh screening is so costly that it would have to be very efficient and permanent to begin with, before it could be

given much consideration as a borer protector. For the screening only, the cost would range from one cent for a two-year-old tree, to about six or seven cents for a 12-year-old tree.

In these tests, screening was so applied that it would stand out all around the tree. A few strands of the wire were pulled out along one edge and the free ends were then passed through the other edge of the screening and bent over, thus securely locking the protector around the tree. The screening was then crimped around the top and securely fastened to prevent adults from entering.

At the end of the first year it was noticed that the screens were rusted out below the surface of the ground. Were it not for this, it would seem that screening would last at least three years. It was found, moreover, that the screening had to be readjusted each year. Another objection against screening was the fact that a tendency to girdle the trees readily developed when screens were tightly fastened around the top.

Examination of 133 screened trees showed that only two were infested in 1915, thus representing a control of 85.9 per cent. In the second year, 15 were infested and the control was only about 51.3 per cent. In the case of the infested trees, it seemed that beetles must have deposited through the meshes at a point where the screening happened to touch the trunk of the tree. Other cases, trees were infested when there was no means of accounting for how the beetle could have deposited its egg in the tree.

Conclusions: 1. That the cost of screening makes it prohibitive as a protector.

2. The danger from girdling is another factor against its use.

Asphaltum

After investigation, it was thought that asphaltum might hold some promise as a borer protection, provided that it did not injure the trees and it was sufficiently permanent not to require much retouching. It was found that two pounds of asphalt were required to cover a twelve-year-old tree, and that one pound would cover about 10 two-year-old trees.

In 1912, some preliminary tests were made on twelve-year-old trees. Results indicated that where the asphalt covered the bark it caused a tendency for excessive deposits of cork to form. The trouble did not appear to be due to the heat of application, because in this case the living tissue would have been killed in places. It was thought that trouble might have been augmented at least by heat which might have been absorbed on account of the black color of the asphalt. This seemed improbable because the injury was no worse on the south,

east or west sides than on the north. From the fact that the bark appeared normal where the asphalt cracked or chipped off, it seemed most likely that the presence of asphalt impaired the process of respiration.

Preliminary tests were made with two-year-old apple trees to see what effect treatment would have. Twenty-four trees were treated at temperatures ranging from 235 to 175 degrees C. The trees were submitted to Professor Hewitt, Plant Pathologist, whose report follows: "The asphaltum tests indicated that trees would stand asphaltum as hot as 203° C. without apparent injury, provided it was quickly applied, though a tree treated from 140 to 150 degrees C. was injured, when the application was prolonged to one-half minute. It thus appears that young trees could stand a high temperature for a short time better than a somewhat lower temperature unduly prolonged."

After the preliminary tests, it was decided to try asphaltum in the tests at the three different temperatures. One at the lowest temperature at which the raw asphalt would spread efficiently (about 150° C.); another at 130° C.; and a third at 115° C. The melting points in the latter two instances were reduced with oils. In order to determine whether it would be desirable to have the oil dry out rapidly, or to have it remain in combination longer, gasoline, kerosene and linseed oil were used. Thus, asphalt was used in seven combinations.

1. Asphalt applied at about 150° C.
2. Asphalt with melting point reduced to 130° C. with gasoline.
3. Asphalt with melting point reduced to 130° C. with kerosene.
4. Asphalt with melting point reduced to 130° C. with raw linseed oil.
5. Asphalt with melting point reduced to 115° C. with gasoline.
6. Asphalt with melting point reduced to 115° C. with kerosene.
7. Asphalt with melting point reduced to 115° C. with raw linseed oil.

As before indicated, in order to see whether some varieties might be more susceptible than others, tests were carried out with three varieties which were considered as fairly representing tough, medium and tender barks. Mammoth Black, Jonathan, and Yellow Transparent were selected.

Our conclusions in regard to asphaltum were:

1. Asphaltum will not make an absolutely borer proof coat, because of its tendency to crack, due, presumably, to the pressure of growing bark in cool weather when the coat is brittle. Exceptions should be noted here in the case of linseed oil mixtures, which remain more plastic.

2. Moisture tends to make asphalt brittle, causing it to flake off.

3. Buds in growing, readily push through the asphalt coat, thereby making it defective.

4. Cracking of asphalt coat is worse with older than with the younger trees.

5. Woolly Aphis was encountered in a number of instances, established beneath the asphalt coat where the tree has apparently shrunken from it.

6. It is the opinion of Professor Hewitt that asphalt injury will, in some instances, be conducive to the entrance of crown gall.

7. Injury to trees was frequent and occurred to such an extent as to warrant discouraging its use altogether as a borer protector. The average for all asphalt treated trees was 22.9 per cent injury, though it ranged as high as 40 per cent, depending on variety of tree and treatment.

8. Injury seemed to vary directly as the heat of application. Raw asphalt caused 26.6 per cent injury. The 130° averaged 22.7 per cent injury and the 115° mixtures averaged 7.9 per cent injury.

9. Our data suggested that the kerosene asphaltum mixtures might cause a little more injury than the other oil mixtures, though this is by no means conclusive.

10. Injury varied with the variety. For all asphalt treated trees it was 15.1 per cent, 21.5 per cent and 25.2 per cent, respectively, for Mammoth Black, Jonathan, and Yellow Transparent.

11. Injury was of two types. (a) One type due, apparently, to scalding of the bark as a result of the heat of application. It was characterized by killing of the bark, usually along one side, which frequently induced a malformed, gally condition, due, presumably, to the attempted healing over of killed bark by the surrounding growing tissue. (b) A second type of injury appeared to have been induced by interference with the normal process of respiration. It was characterized by greatly enlarged lenticels, frequently accompanied by excessive deposits of cork.

12. Injury in the young trees was less the second year than the first, which indicated that it was due mostly to the heat of application.

13. Injury of the second year was confined to a corky type, due to impairing of the process of respiration.

14. The older trees appeared not to have been injured by scalding, but seemed to be injured by the impairment of the process of respiration, as indicated by immense deposits of cork.

15. As a protection against borers, asphalt gave protection of 82.1 per cent the first year for all trees.

16. The asphaltum combinations with oil apparently give a little better protection than the raw asphalt, due, presumably, to the fact that the oil mixtures were more plastic and permitted the growth of the trees without cracking the asphalt coat. Raw asphalt averaged

a protection of 69.1 per cent, but all the oil mixtures averaged 85.9 per cent.

17. Though the trees were retouched, treatment was less effective the second year than the first, the average protection the second year being 7.7 per cent as against 82.1 per cent for the first.

18. Up to a certain age, it appeared that asphalt varies in efficiency inversely as the age of the tree. In other words, the older the trees the less efficient the treatment.

As a result of our investigations at Berryville, we concluded that the most practical manner of handling the borer properly is by worming the tree at the right time every year.

Summary

1. That the protection offered by white lead is not commensurate with returns.

2. That pruning compound is worthless as a borer protector.

3. That paper wrappers and wooden veneers, from first observations, appear to be impracticable.

4. That the cost of screening is too great to warrant its use as a borer protector.

5. That the use of asphaltum is attended with injury and that its efficiency as a borer protection is not worthy of the risk to the trees.

6. That worming the trees during the months of August and in early September is the most practicable as well as the cheapest method for the controlling of the borer.

Vice-President G. A. Dean: If there is no discussion, we will now listen to a paper by Mr. George H. Lamson, Jr.

MERCURIAL OINTMENT, AN EFFECTIVE CONTROL OF HEN LICE

By G. H. Lamson, Jr., *Storrs, Conn.*,

Insecticides, such as the arsenate of lead, lime sulphur, hellebore, hydrocyanic acid gas, carbon bisulphide and nicotine solutions, are of known value and it is from these that the economic entomologist usually draws for the direct control of insects.

To most of you the problems of the control of insects affecting the products of the orchard, field, forest and garden are of most interest, though from time to time your attention is directed to those animal parasites that are of much economic importance.